

Scientific Inquiry

6-1 The student will demonstrate an understanding of technological design and scientific inquiry, including the process skills, mathematical thinking, controlled investigative design and analysis, and problem solving.

6-1.1 Use appropriate tools and instruments (including a spring scale, beam balance, barometer, and sling psychrometer) safely and accurately when conducting a controlled scientific investigation.

Taxonomy Level: 3.2-B Apply Conceptual Knowledge

Previous/future knowledge: In previous grades, students used magnifiers and eyedroppers (K-1.2), rulers (1-1.2), thermometers, rain gauges, balances, and measuring cups (2-1.2), beakers, meter tapes and sticks, forceps/tweezers, tuning forks, graduated cylinders, and graduated syringes (3-1.5), a compass, an anemometer, mirrors, and a prism (4-1.2), and a timing device and a 10x magnifier (5-1.4) safely, accurately, and appropriately. In future grades, students will use these tools when appropriate as well as learn new tools to use when collecting scientific data. A complete list of tools can be found in Appendix A of the Academic Standards.

It is essential for students to know that different instruments or tools are needed to collect different kinds of data.

- A *spring scale* is a tool used to measure the weight of an object or the force on an object.
 - Some spring scales have a slider that moves in response to the weight/force of an object. The measurement is read on one of two scales located on either side of the slider.
 - Some spring scales have a spring that is visible through a clear plastic tube with two scales labeled on either side of the tube.
 - Before an object is attached to the spring scale, make sure the marker is on the zero (0) by adjusting the slider or knob usually found on the top of the scale.
 - A spring scale measures weight or force in newtons (N).
- A *beam balance* (triple) is a tool used to measure the mass of an object.
 - The beam balance contains a pan or platform, three beams with riders/sliders and a pointer.
 - Before measuring, make sure all riders/sliders are set at zero (0), the pointer is in line with its zero (0) mark and the pan is clean.
 - Place an object to be measured on the pan or platform. If the object is placed in a container or on weighing paper, the mass of the container or paper needs to be subtracted from the final mass of the object.
 - Three beams are found on the side opposite of the pan. Each beam is marked in different increments: 100 grams, 10 grams, and tenths (0.1) of a gram up to 10 grams.
 - After placing the object on the pan, the pointer will rise.
 - To determine the mass of the object, gently slide the riders/sliders across the beams until the pointer lines up exactly with the zero (0) mark on the scale. Be sure the riders/sliders with notches are securely placed in their notches.
 - The mass is calculated by adding the sum of the measures indicated by the riders/sliders.
 - Move all riders/sliders back to zero (0) when finished.
 - A beam balance measures the mass of an object in grams (g).

NOTE TO TEACHER: Students do not need to estimate to the hundredths (0.01) of a gram. Measurements estimating to 0.05 of a gram on a triple beam balance will be an expectation in high school Physical Science.

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- A *barometer* is an instrument used to measure air pressure or a change in pressure readings.
 - Many of the barometers have qualitative descriptions of weather conditions associated with air pressure but this alone should not be used to forecast weather.
 - To read your barometer, first tap the glass lightly, but firmly, to ensure that the *reading pointer* attached to the linkage mechanism inside the barometer is not sticking.
 - The other pointer that is found on most instruments is the *set pointer* and is usually made of brass.
 - The set pointer can be turned by means of the knob at the center of the glass so that it covers the reading pointer. If the reading pointer has moved between readings then it can be determined that the pressure is now lower or higher and by how much.
 - A barometer scale is measured in millimeters or inches of mercury or millibars (mb).
- A *sling psychrometer* is a tool used to measure relative humidity.
 - A sling psychrometer is made of two thermometers—a wet bulb and a dry bulb—held together by a handle.
 - The wet bulb thermometer is covered with a piece of cloth and moistened.
 - The two thermometers are then moved through the air. After a period of time the temperature of each thermometer is recorded. A relative humidity chart is used to determine the relative humidity percent.

It is essential for students to use care when handling these tools when conducting an investigation.

- Chemicals should not be placed directly on the beam balance. Place them in a measuring tray or weighing paper.
- Always move the riders of the beam balance to the left after massing an object.
- Care should be taken not to break the barometer and sling psychrometer.

It is also essential for students to use tools from previous grade levels that are appropriate to the content of this grade level such as magnifiers, rulers (measuring to millimeter), rain gauges (measuring in centimeters or inches), thermometers (measuring in °F and °C), forceps/tweezers, graduated cylinders (measuring at the meniscus to milliliters), graduated syringes (measuring to milliliters), meter sticks and meter tapes (measuring in meters, centimeters, or millimeters), anemometers (measuring in miles per hour), compasses, 10x magnifiers, or timing devices (measuring in minutes or seconds) to gather data.

NOTE TO TEACHER: See information in previous grades regarding how to use each tool. All temperature readings during investigations will be taken using the Celsius scale unless the data refers to weather when the Fahrenheit scale is used.

It is not essential for students to use hygrometers, digital balances, ammeters, voltmeters, or multimeters. Tools from previous grades that are not appropriate to the content of this grade level are not essential; however, these terms may be used as distracters (incorrect answer options) for assessment, for example eyedroppers, pan balances, measuring cups, beakers, tuning forks, mirrors (plane/flat), or prisms. Students do not need to convert measurements from English to metric or metric to English. Measurements estimating to 0.05 of a gram on a triple beam balance will be an expectation in high school Physical Science.

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Assessment Guidelines:

The objective of this indicator is to *use* tools safely, accurately, and appropriately when gathering data; therefore, the primary focus of assessment should be to apply correct procedures to the use of a spring scale, beam balance, barometer, and sling psychrometer, and other tools essential to the grade level that would be needed to conduct a science investigation. However, appropriate assessments should also require students to *identify* appropriate uses for a spring scale, beam balance, barometer, and sling psychrometer; *illustrate* the appropriate tool for an investigation using pictures, diagrams, or words; *recall* how to accurately determine the measurement from the tool; or *recognize* ways to use science tools safely, accurately, and appropriately.